PROCEEDINGS

OF

THE ROYAL IRISH ACADEMY.

1846–7. No. 67.

May 24th, 1847.

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Librarian, in the Chair.

M. Donovan, Esq., continued the reading of his paper on the Nature of the Agency which produces the Effects called Galvanic, Electro-magnetic, Magneto-electric, and Thermo-electric.

The next subject to which Mr. Donovan called the attention of the Academy was the instantaneous charge which a Leyden battery receives by a momentary contact with an extensive voltaic series. This has been always adduced as an argument in support of the affirmed enormous quantity of electricity which constitutes the voltaic current. Van Marum charged a Leyden battery of twenty-five jars by a momentary connexion with a pile consisting of silver coins and zinc discs, one inch and a half in diameter. The battery and pile were thus charged to the same intensity, so feebly, however, as to produce divergence in a gold leaf electrometer to the extent of five-eighths of an inch; but the shock from the battery was only equivalent to half that of the pile. Facts and calculations were adduced to show that the charge of electricity in this Leyden battery, when thus charged, could not have exceeded the quantity of two or three one-inch sparks. Sir H.

Davy charged a Leyden battery with 2000 pairs of zinc and copper plates, each plate exposing thirty-two superficial inches of metal to the exciting liquid; the total surface being 128,000 square inches. On making the proper connexions, with the Leyden battery, "either a shock or a spark could be *perceived*." Thus the shock was barely perceptible; and to this Mr. Donovan added his own testimony of the shock from a Leyden battery, charged by 1000 pairs of plates, which he represented as exceedingly feeble.

In support of the inference drawn of the trifling nature of the shock, and the inconsiderable quantity of electricity which a Leyden battery is capable of communicating, when charged by a voltaic series, Mr. Donovan detailed an experiment made by Professor E. Davy and himself, in which twenty Wedgwood ware troughs, each containing ten cells, were employed, with a total number of 200 pairs of plates excited by dilute acids. When charcoal points, fixed to the polar wires, were brought into contact, an instantaneous burst of light, of dazzling splendour, announced that the series was in high action. On attempting to charge a Leyden battery of twelve or thirteen square feet of coated surface with this voltaic series, neither shock nor spark could be obtained. Yet it was proved that the charge communicated to the Leyden battery by three turns of a very small electric machine was sufficient to enable the battery to give a spark visible in day-light, the three turns producing three weak sparks of one inch in length. Six turns of the cylinder, that is six one-inch sparks, enabled the Leyden battery to give a sensible shock. This failure was supposed to be explicable by the small size of the Leyden battery compared with that of Van Marum, the ratio being as $12\frac{1}{3}$ to $137\frac{1}{2}$.

So far as all the experiments, whether these last, or those of Van Marum or Davy, are concerned, there seems to be no evidence of great quantity of electricity in the voltaic series. But, even if there were, it was stated that none of the fore-

going cases are applicable to the doctrine, and that no support can be derived from them. A series of arguments was then made use of, which cannot be abridged, to prove that a Leyden battery has never yet been really charged by the voltaic current; that the circumstances under which the charge has been supposed to have been communicated are such as to render the thing impossible; and that hence the so-called charge of a Leyden battery by a voltaic current does not prove the circulation of an enormous quantity of electricity in a voltaic series, but rather shows that the agent which gives the voltaic shock is not the same as that which acts in the phenomena of ordinary electricity. The shock of the coil apparatus was adduced as an evidence to the same effect; and, finally, it was observed that the sensation which constitutes the shock ought not to be received as evidence on either side of the question, since sensations depend more on the organ acted on than on the agent; and in support of this opinion a number of instances were adduced.

Whatever difference of opinion may exist relative to the nature of positive and negative electricity, it appears to be a position universally agreed to, that, when equal to each other, and at liberty to act, they mutually neutralize and destroy each other's properties; all symptoms of both disappear; a condition of absolute quiescence results; that of equilibrium is induced; and this state manifests no electrical properties. The poles of a voltaic battery, being in the positive and negative states, conform to the general law: when unconnected, they manifest their electrical condition; but as soon as they are connected by a good conductor, all symptoms of electricity vanish. This has been proved in a remarkable manner by Mr. Gassiott with a water battery consisting of 3520 pairs, exhibiting great power over even a *distant* gold-leaf electrometer while the poles were unconnected, but losing all energy when they were united.

Yet it is at the moment when the poles are united, and

when all symptoms of electricity vanish, that the connecting wire of the voltaic series becomes magnetic. Is there not in this fact something repugnant to the idea that electricity is the agent. To admit that the two states of electricity, after having neutralized and virtually annihilated each other's properties, should at that moment be more active in calling into operation the magnetic power, would be to declare that in the natural state of the equilibrium of the electric fluid the magnetic influence must be perpetually active; that is, that all the bodies in nature are magnets. This objection applies to the opinion of those who maintain that electricity, considered as a simple element, is the cause of, or is identical with, or excites magnetism; but not, as Mr. Donovan conceived, to his own view, stated in the beginning of this Essay, relative to the supposed compound nature of the electric fluid.

The boldest of all the hypotheses of magnetism, and the most ingeniously supported, was described to be that of Ampere, who denies the existence of any magnetic agent called into action by electricity, but affirms the identity of both powers. Some experiments were described which cannot be here detailed, the object of which was to show that magnetism and electricity observe different laws, and that one may exist when the other is not present.

A word has of late years come into common use, which, while it explains nothing, conceals the solecism contained in the notion of neutralized electricities retaining their energies: the new term is the "current." The counter-current is thus kept out of view, which is the grand difficulty, because it must antagonize and destroy the current. This new current, consisting of both electricities, instead of being powerless, as was formerly the nature of such, is now said to be capable of exerting peculiar power; but it no longer harmonizes with those facts from which our knowledge of the true current was derived. Faraday's views of the current were examined, and the conclusion drawn that they are inconsistent with each other, and

with facts. Mr. Donovan terminated this part of the inquiry with the following observations:

"I have thus freely expressed my opinions relative to the current, fearing that the old legitimate sense has been lost sight of; that many have understood it to mean something more than is warranted by *proved* properties; and that the universally admitted identity of the agent in electric and voltaic phenomena has emboldened philosophers to attribute qualities to the former which belong only to the latter. On the whole, I conceive that the current, in its modern acceptation, instead of explaining voltaic phenomena, is calculated to mislead; and that it is of no avail in obviating the difficulties which beset the alleged simultaneous operations of the two states of electricity, when present in a state of commixture, and which, instead of being at that moment in their condition of greatest energy, should be destitute of all sensible properties."

Sir Robert Kane read a communication from the Rev. Dr. Callan, Professor of Natural Philosophy in the College at Maynooth, on some improvements in the construction and use of the Galvanic Battery.

"Some time ago, whilst I was reflecting on the principle of action of Grove's and Bunsen's batteries, it occurred to me that lead might be substituted for the platina of Grove's and the carbon of Bunsen's. I put into the porous cell of a Grove's battery a plate of lead about one-sixteenth of an inch thick, two inches broad, and six inches long. I found that the voltaic current produced by the lead, excited by a mixture of concentrated nitric and sulphuric acid, was very powerful. I afterwards compared the power of the leaden battery with that of a Grove's battery of the same size, by sending at the same time, but in opposite directions, through the helix of a galvanometer, the current produced by the two batteries. Both batteries were charged with the same acids. The voltaic cur-